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Research Article

Comparative efficacy of neem (*Azadirachta indica* A. Juss) powder against cowpea beetle (*Callosobruchus maculatus* Fab.) on stored cowpea seeds

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Abstract

The efficacy of some powders against cowpea beetle, *Callosobruchus maulatus*, obtained from different parts of neem plant was investigated in. The design used was completely randomized design. Six treatments were used which were designated as NRP, for root powder; NSTP, for neem stem powder; NLP, for leaf powder; NSP, for neem seed powder; Actellic dust and control in which no insecticide used. The treatments were replicated four times. The parameters assessed were oviposition, progeny development, percentage mortality, percentage seed damage and seed viability. The neem powders had effectively protected the cowpea seeds during the storage period of twelve weeks. But the protection given by neem seed powder and neem root powder were higher than that of neem stem powder and neem leaf powder. There was no significant difference (P< 0.05) between the two powders (neem seed and neem root powders) and Actelic dust. Therefore, Neem seed powder and neem root powder, which are readily available cheap and less toxic to the immediate consumers of the seeds, can be used as better alternatives for protecting cowpea seeds.

Keywords: Actellic, *Callosobruchus,* cowpea, neem, powder

INTRODUCTION

The pulse beetle, *Callosobruchus maculatus* Fab. (Coleoptera: Bruchidae), is the most important insect pest of cowpeas (Oparaeke and Daria, 2005) lentils, green gram, and black gram. The larvae bore into the pulse grain which become unsuitable for human consumption, viability for replanting, or for the production of sprouts. The beetles are important pests of pulse crops in Asia and Africa under storage conditions (Ogunwulu and Idowu, 1994; Okonkwo and Okoye, 1996; Mulatu and Gebrmadhin, 2000; Raja *et al.*, 2000; Ajayi and Lale, 2001; Tapondjiu *et al.*, 2000).

Serious problems of genetic resistance by insect species, pest resurgence, residual toxicity, photo toxicity, vertebrate toxicity, widespread environmental hazards and increasing costs of application of the presently used synthetic pesticides have directed the need for effective, biodegradable pesticides (Zettler and Cuperus, 1990; Glenn et al., 1994; Ewete *et al.*, 1996; Guedes *et al.*, 1997; Talkder and Howse, 2000; Elhag, 2000). This awareness has created worldwide interest in the development of alternative strategies, including the re-examination of using plant derivatives against agriculturally important insect-pests. Plant-derived materials are more readily biodegradable. Some are less toxic to mammals, may be more selective in action, and may retard the development of resistance. Their main advantage is that they may be easily and cheaply produced by farmers and small-scale industries as crude, or partially purified extracts (Rahman and

Talukder, 2006). Also the concern for misuse of synthetic insecticides and toxic residues in food have resulted in search of botanicals which can serve as good alternative for controlling stored pests (Bamaiyi *et al.*, 2007).

However, neem tree (*Azadirachta indica* A.Juss) from the *maliaceae* family has long been used for both against insect and improving human health (Raguruman and Singh, 2000). The insecticidal activity of neem plant is largely due the presence of a substance called Azadiractin (Jain *et al,* 2002). The availability of Neem plant in Nigeria has made it a good alternative bio-pesticide as it is found almost everywhere in the country. Several workers had shown the importance of neem product in controlling cowpea beetle *C. maculatus*. Wehdi *et al.* (2013) had found that Neem seed extract, neem seed oil and neem seed powder have high toxicity against *C. maculatus.* It also retards f1 emergence. Earlier finding by *Rani et al.* (2007) and Mundi *et al.* (2012) have shown the effectiveness of neem kernel powder and neem bark powder against *C. maculatus*. Neem products generally were used to protect cowpea seeds in storage. Although they are not as effective as synthetic insecticides, they do not impair germination of stored products (Sehgal and Ujagar, 1990).

The objective of this study, therefore, was to compare the efficacy of different neem powders for the control of cowpea beetle, *C. maculatus* on a stored cowpea seeds. And also to identify the most effective of the powders for cowpea seeds protection.

MATRIALS AND METHODS

Different parts of neem plant were obtained from the bush in Kabo, Kano State and Northern Nigeria. The parts were, bark of young lateral roots, stem bark, leaves and the seeds. The outer cover of the seed was removed, leaving the kernel. These parts were dried separately under the shade for three weeks. Thereafter, each neem part was independently ground using mortar and pestle and sieved with 0.1 mm wire mesh size. The pulverized contents obtained in each case were each kept in separate polyethylene bags and kept in the laboratory fridge until ready for use.

Cowpea variety (SAMPEA 7) was used for the study. The grains were screened to remove contaminants and infested seeds. Screened seeds were fumigated with phostoxin in an air tight container for 24 hours to kill any insect present. The seeds were later spread on a laboratory bench for three days to allow or dissipation of fumigant effect.

One hundred grams of the fumigated seeds were placed in each kilner jar. Each of the powders of the neem parts were applied at 10g / 100g of the seeds and replicated three times. Pirimiphos methyl (Actelic dust 2%) applied at 2g/100g of seeds was used as standard insecticide. Each treatment was shaken vigorously for proper mixing. And allowed to stand for an hour before introducing ten (10) pairs of newly emerged adult bruchid into each jar. The adult bruchids were obtained from insectary. There was a control without treatment. The kilner jars were arranged in a randomized complete block design. Adult mortality records were taken from each jar at 24,and 48 hrs. Data on oviposition rates were taken after two weeks post treatment by counting the number of eggs lay per random sample of 20 seeds. Progeny development (F1, F2 and F3) were recorded at 4, 8 and 12 weeks respectively. Cowpea damage was assessed at the end of 12 weeks by randomly selecting 100 seeds from each treatment jar and counting the number of emergent holes on each. Viability test was also conducted by picking randomly 20 seeds from each jar, which were moistened in petri dishes, lined with filter paper and allowed to stand on the laboratory bench for seven days.

RESULTS

The result in Table 1 shows that, Actellic dust had significantly hindered egg laying (2.0), followed by neem seed powder (NSP) and neem root powder (NRP) that have 4.7 ad 4.9 respectively. There was no significant difference ($P< 0.05$) between NSP and NRP. The treatment without any insecticidal treatment had the highest number of eggs laid (250). Neem leaf powder (NPL) and neem stem powder (NSTP) have lower eggs laid compared to the NSP and NRP. Lowest F1, F2 and F3 emergence was recorded in the seeds treated with Actellic dust followed by NSP and NRP. However there was no significant difference ($P<0.05$) among them. There was progressive progeny development in the seed without pesticide treatment (from 229.7, in F1 to 401.0, in F3).

Mortality was found to be the highest in the seeds treated with Actellic dust (Table 2). However, NSP and NRP had significantly caused mortality of the beetle (16.7 and 16.0 at the end of 24 hrs, respectively). There was no significant difference ($P<0.05$) among the three treatments (Actellic dust, NSP and NRP). Among the Neem powders used NLP has the lowest number of beetle that were found dead at both 24 and 48hrs (14.0 and 16.3 respectively). This was followed by the untreated control (0 and 0.3 at 24 and 48hr respectively).

Seed damage as shown in Table 3 was highest in the without insecticidal treatment. Lowest number of seeds were damage in treatment with Actelic dust (3.0), followed by NSP (5.3) and NRP (8.5). There was no significant difference ($P<0.05$) among the three treatments. Consequently more seeds were protected by these treatments. At the end of the

storage period of 12 week, most of the seeds in the untreated control (77.3%) were damaged, followed by NLP (25.4%).Best seed protection was obtained in the treatments with Actellic dust (97.0 %), NSP (94.7%) and NRP (91.5%). And there was no significant difference (P< 0.05) among them.

At the end of the storage period of 12 week, the result on seed viability (Table 4) shows that most seed in the untreated control did not germinate. Therefore it has the lowest germination percentage (16%). NSP has the highest germination percentage (94.5%), followed by Actellic dust (93.4 %) and NRP (90.5%). Among the neem powders used, NLP has the lowest germination percentage (73.5%) followed by NSTP (81.0%)

Table 1. Effects of different neem powders on oviposition and progeny development of *C. maculatus* on cowpea grains

Treatment	Mean no of eggs laid (20 seeds)	Mean no of progeny			%F1
		F1	F2	F3	
NRP	4.9c	2.7d	4.3d	8.7d	55.1
NSTP	12.7c	9.0c	21.3c	26,0c	70.0
NLP	13.3b	10.7b	27.3b	31.3b	80.5
NSP	4.7c	2.0d	4.3d	7.7d	43.0
Actellic dust	2.0d	0.3d	2.3d	5.0d	15.0
Co (no insecticide)	250.0a	22.7a	303.0a	401.0a	91.5
CV	2.1	6.6	5.2	2.9	
SE±	1.0	3.0	3.2	2.4	

Means in the column accompanied by the same letter (s) are not significantly difference at (P< 0.05%) using New Duncan Multiple Range Test (DMRT).
NRP-neem root powder; NTSP- neem stem powder; NLP- neem leaf powder; NSP- neem seed powder

Table 2. Percentage mortality of *C. maculatus* on stored cowpea grains at 24 and 4hrs post treatment with different neem powder

Treatment	Mean no of insects used	Mean no of insects killed		Percentage mortality	
		24hrs	48hrs	24hrs	48hrs
NRP	20	16.0ab	18.7b	80.0	93.5
NSTP	20	15.7b	7.0b	78.5	85.0
NLP	20	14.0c	16.3b	70.0	81.5
NSP	20	16.7ab	19.0a	93.5	95.0
Actellic dust	20	17.7a	19.7a	88.5	98.5
Co (no insecticide)	20	0.0d	0.3c	0.0	1.5
CV		4.7	4.9		
SE±		0.6	0.8		

Means in the column accompanied by the same letter (s) are not significantly difference at (P< 0.05%) using New Duncan Multiple Range Test (DMRT).
NRP-neem root powder; NTSP- neem stem powder; NLP- neem leaf powder; NSP- neem seed powder

Table 3. Percentage damage of cowpea seed by *C.maculatus* after 12 weeks of treatment with different neem powders

Treatment	Mean no of gain selected	Mean no of holed grain	Percentage grain damaged	Percentage grain protected
NRP	100	8.5c	8.5	91.5
NSTP	100	20.4	20.4	79.6
NLP	100	25.4b	25.4	74.6
NSP	100	5.3c	5.3	94.7
Actellic dust	100	3.0c	3.0	97.0
Co(no insecticide)	100	77.3a	77.3	22,7
CV		24.3		
SE±		5.7		

Means in the column accompanied by the same letter (s) are not significantly difference at (P< 0.05%) using New Duncan Multiple Range Test (DMRT).
NRP-neem root powder; NTSP- neem stem powder; NLP- neem leaf powder; NSP- neem seed powder

Table 4. Effect of different neem powders on cowpea seed viability after 12 weeks of post treatment

Treatment	Mean no grain tested	Mean no of grain germinated	Mean percentage grain germinated
NRP	20	18.4a	92.0
NSTP	20	16.2b	81.0
NLP	20	14.7c	73.5
NSP	20	18.9a	94.5
Actellic dust	20	18.7a	93.5
Co (no insecticide)	20	3.3d	16.5
CV		6.5	
SE±		0.9	

Means in the column accompanied by the same letter (s) are not significantly difference at (P< 0.05%) using New Duncan Multiple Range Test (DMRT).
NRP-neem root powder; NTSP- neem stem powder; NLP- neem leaf powder; NSP- neem seed powder

DISCUSSION

The result of this study has shown how the various neem powders controlled the cowpea beetle *Callosobruchus mculatus* in many ways, which include suppression of egg laying and progeny development. The powder from the neem had significantly reduced the ability of beetle to lay eggs. This consequently retarded progeny development, which is evident in F1 generation. In a similar experiments, Rani et al. (2007) and Mudi et al. (2012) ad used neem seed kernel powder and stem bark powder, respectively to control the beetle in a stored cowpea. However, Neem leaf powder and neeem stem powder were not as effective as neem seed powder and neem root powder. Tanzabil (1987) evaluated different neem powders and oil and found that leaf powder was less effective compared to the rest as well as the neem oil. When compared with the standard insecticide (Actellic dust). In term of progeny development retardation, neem seed powder and neem root powder were found to be more effective than other neem powders. Although the dust is more effective than the two, there was no significant difference among them. Therefore, the two (neem seed power and neem root powder) should be preferred as they are safer to the environment and less harmful to consumers.

Neem plant contains a substance called Azadirachtin, a substance that is biocidal in its properties (Jain *et al.,* **2000**). Probably, the superiority of neem seed and neem root powders over neem stem and neem leaf powders could be attributed to .a much higher concentration of Azardirachtin in them. This is because the roots and the seeds are areas of higher metabolic activities; as more substance are channeled to these areas for rapid cell division and development. That was why the cowpea seeds that were treated with neem seed powders were better protected after 12 weeks of storage. There was no significant difference between them and the seeds treated with Actellic dust.

Although there was no significant differences among the seeds treated with neem seed powder, neem root powder and the Actellic dust when the viability test was conducted at the end of the storage period of 12 months, seeds treated with neem seed powder were better germinated. They germinated even better than the seeds treated with the Actellic dust. The viability of the seeds treated with Actellic dust might have been affected by the synthetic insecticide. This was in conformity with the finding by Sehgal and Ujagar (1990). They discovered that, seeds that were treated with neem product were less protected compared with seeds treated with synthetic insecticides. However, they have higher viability, because neem products do not impair germination of stored gains.

In conclusion powders obtained from different part of neem plant, as shown by this study can be used to protect cowpea seeds. Neem seed powder and neem root powder can be used in place of the synthetic insecticides, since there was no significant difference between them and the synthetic insecticide (Actellc dust) used. However, neem seed powder should be preferred over neem root powder, because of the difficulty in obtaining neem root powder, as it involve digging out the roots, which my be very strenuous. Generally, the neem powders should be used to protect cowpea seeds against cowpea beetle, *C. macultus,* because they are readily available cheaper and less toxic to the immediate consumers.

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